

What Is Claimed Is:

1 1. A method of forming a bottle-shaped trench,
2 comprising the steps of:
3 providing a substrate;
4 forming a trench in the substrate, wherein the trench has
5 a trench surface with an upper portion and a lower
6 portion beneath the upper portion;
7 forming a dielectric layer on the trench surface at the
8 lower portion;
9 using the dielectric layer as a mask, performing a
10 nitridation procedure to form a nitride film on the
11 trench surface at the upper portion;
12 removing the dielectric layer; and
13 using the nitride film as a mask, performing an isotropic
14 etching procedure to form a space in the trench at
15 the lower portion.

1 2. The method according to claim 1, wherein the substrate
2 comprises single crystal silicon.

1 3. The method according to claim 1, wherein the
2 dielectric layer is an oxide layer formed by thermal oxidation
3 or CVD.

1 4. The method according to claim 1, wherein a thickness
2 of the dielectric layer is 10~200Å.

1 5. The method according to claim 1, wherein the formation
2 of the dielectric layer on the trench surface at the lower
3 portion comprises the steps of:

4 forming a conformal dielectric layer on the trench surface;
5 filling a photoresist layer in the trench;
6 partially etching back the photoresist layer to form a
7 remaining photoresist layer on the dielectric layer
8 at the lower portion;
9 using the remaining photoresist layer as a mask, removing
10 the dielectric layer at the upper portion; and
11 removing the remaining photoresist layer.

1 6. The method according to claim 1, wherein the
2 nitridation procedure is a rapid thermal nitridation (RTN)
3 procedure.

1 7. The method according to claim 6, wherein an operating
2 temperature of the rapid thermal nitridation procedure is
3 800~1200°C.

1 8. The method according to claim 1, wherein a thickness
2 of the nitride film is 15~30Å.

1 9. The method according to claim 1, wherein the formation
2 of the trench comprises the steps of:
3 forming a pad layer on part of the substrate; and
4 using the pad layer as a mask, removing part of the
5 substrate to form the trench therein.

1 10. The method according to claim 9, wherein the pad layer
2 comprises a pad oxide layer and a nitride layer.

1 11. A method of forming a bottle-shaped trench,
2 comprising the steps of:

3 providing a silicon substrate, wherein the silicon
4 substrate comprises single crystal silicon;
5 forming a trench in the silicon substrate, wherein the
6 trench has a trench surface with an upper portion and
7 a lower portion beneath the upper portion;
8 forming a conformal dielectric layer on the trench surface;
9 filling a photoresist layer in the trench;
10 partially etching back the photoresist layer to form a
11 remaining photoresist layer on the dielectric layer
12 at the lower portion;
13 using the remaining photoresist layer as a mask, removing
14 the dielectric layer at the upper portion to leave
15 a remaining dielectric layer on the trench surface
16 at the lower portion;
17 removing the remaining photoresist layer;
18 using the remaining dielectric layer as a mask, performing
19 a rapid thermal nitridation (RTN) procedure to form
20 a Si_3N_4 film on the trench surface at the upper
21 portion;
22 removing the remaining dielectric layer; and
23 using the Si_3N_4 film as a mask, performing a wet etching
24 procedure to form a space in the trench at the lower
25 portion.

1 12. The method according to claim 11, wherein a thickness
2 of the conformal dielectric layer is a SiO_2 layer having a
3 thickness of 10~200Å formed by thermal oxidation or CVD.

1 13. The method according to claim 11, wherein an operating
2 temperature of the rapid thermal nitridation procedure is
3 800~1200°C.

1 14. The method according to claim 11, wherein a thickness
2 of the Si_3N_4 film is 15~30Å.

1 15. The method according to claim 11, wherein the
2 formation of the trench comprises the steps of:
3 forming a pad layer on part of the substrate; and
4 using the pad layer as a mask, removing part of the
5 substrate to form the trench therein.

1 16. The method according to claim 15, wherein the pad
2 layer comprises a pad oxide layer and a nitride layer.